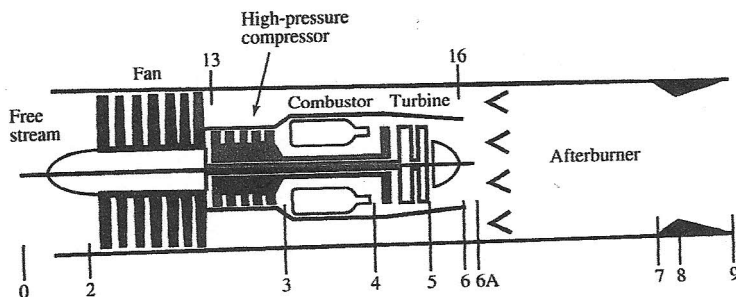


## 7-6 TURBOFAN WITH AFTERBURNING—MIXED EXHAUST STREAM

Most high-speed military aircraft require an afterburner for thrust augmentation at certain flight conditions (e.g., takeoff, high-speed turns, etc.). Figure 7-22a shows the cross section of a mixed-flow afterburning turbofan engine. This engine cycle is used in many of these aircraft. It has several advantages over the turbofan with separate exhausts which was analyzed in the previous section: (1) one variable-area exhaust nozzle, (2) one augmenter (afterburner), and (3) cold bypass air to cool the afterburner liner. Also, mixers can improve



**FIGURE 7-22a**  
Station numbering for mixed-flow turbofan engine with afterburner.

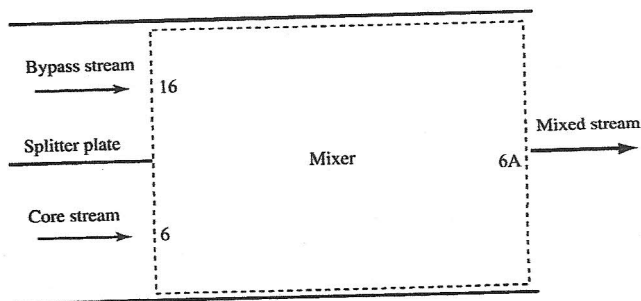
engine performance when the afterburner is “off” or not present (Refs. 4 and 30).

In our modeling of the ideal cycle for the mixed-flow afterburning turbofan engine (see Chap. 5), we first defined the temperature and pressure ratios of the mixer as

$$\tau_M = \frac{T_{t6A}}{T_{t6}} \quad \text{and} \quad \pi_M = \frac{P_{t6A}}{P_{t6}} \quad (5-71)$$

We also assumed that the total pressures of the two entering streams are equal ( $P_{t6} = P_{t16}$ ) and that the mixer pressure ratio  $\pi_M$  was unity. The mixer temperature ratio  $\tau_M$  for the ideal cycle was obtained from an energy balance of the mixer.

The mixer temperature and pressure ratios defined in Eq. (5-71) will be used in the analysis of this engine cycle with losses. The mixer temperature ratio  $\tau_M$  will be obtained from an energy balance of the mixer. In addition, we assume that the mixer pressure ratio  $\pi_M$  is the product of the pressure ratio of



**FIGURE 7-22b**  
Ideal constant-area mixer.

